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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/662,845

09/15/2003

Ming-Fang Wang

67,200-908

1193

47390

7590

04/05/2005

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EXAMINER

NGUYEN, CUONG QUANG

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 04/05/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

H.A

<b>Office Action Summary</b>	Application No. 10/662,845	Applicant(s) WANG ET AL.	
	Examiner Cuong Q. Nguyen	Art Unit 2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**.      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-32 is/are pending in the application.
- 4a) Of the above claim(s) 2-4 and 13-32 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1 and 5-12 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. ____. |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date ____. | 6) <input type="checkbox"/> Other: ____.  |

**DETAILED ACTION**

***Election/Restriction***

1. Applicant's election without traverse of Embodiment I, claims 1 and 5-12 is acknowledged.

***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 11 and 12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 11 recites the limitation "the polysilicon layer" in line 2. There is insufficient antecedent basis for this limitation in the claim.

***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 1, 5 and 8 are rejected under 35 U.S.C. 102(a) as being anticipated by Solomon et al. (US 6,603,181).

Art Unit: 2811

Regarding claim 1, Solomon et al. discloses a method for forming a gate stack having improved electrical properties in a gate structure forming process comprising the steps of: providing a semiconductor substrate (12); forming a metal oxide layer (16) (col.3 lines 55-60) over an exposed portion of the semiconductor substrate; and, forming a layer of electrode (18) over the metal oxide layer in a nitrogen containing ambient (col.5 lines 15-20).

Regarding claims 5, 8, Solomon teaches that metal oxide layer is formed of Y<sub>2</sub>O<sub>3</sub> or HfO<sub>2</sub> (the same material in the present invention) having a dielectric constant of greater than about 20 and having a thickness about 20 nm or less.

### **Claim Rejections - 35 USC § 103**

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 5, 6, 7, 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hegde et al. (US 6,717,226) in view of Thakur et al. (US 5,425,392).

Regarding claims 1, 5, 8, Hegde et al. et al. discloses a method for forming a gate stack having improved electrical properties in a gate structure forming process

Art Unit: 2811

comprising the steps of: providing a semiconductor substrate (12); forming a metal oxide layer (26) (a HfO<sub>2</sub> layer with a dielectric constant of greater than about 20. Col.2 lines 40-51) over an exposed portion of the semiconductor substrate; and, forming a layer of electrode (a polysilicon layer 16) (col.2 lines 5-6) over the metal oxide layer. See Fig.1 and Fig.2.

Hegde et al. does not explicitly teach that the polysilicon electrode is formed in a nitrogen containing ambient.

Thakur et al. teaches that a polysilicon gate electrode (20) is doped with impurities in a nitrogen containing ambient in order to reduce the sheet resistance of the gate electrode. See abstract and col.4 lines 22-31.

It would have been obvious to one of ordinary skill in the art to form the gate electrode in a nitrogen containing ambient as taught by Thakur et al. in Hegde et al.'s device in order to reduce the sheet resistance of the gate electrode.

Regarding claims 6 and 7, Hegde et al. teaches that metal oxide layer is formed of HfO<sub>2</sub> having a dielectric constant of greater than about 20 and having a thickness about 20 angstroms (it is noted that the HfO<sub>2</sub> with the thickness of about 20 angstrom has a dielectric thickness equivalent to a silicon dioxide dielectric thickness of less than about 20 Angstroms). Col.3 lines 12-15.

Regarding claim 9, Hegde et al. teaches that the metal oxide is formed of an atomic layer deposition (ALD) method. Col.2 lines 64-67.

Art Unit: 2811

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hegde et al. in view of Thakur et al. and further in view of Yu et al. (US 6,573,193).

The combination of Hegde et al. and Thakur et al. teaches all the limitations of claim 9 as shown above. However, this combination does not explicitly teach that an ozone containing oxidation process is carried out to treat the metal oxide layer following the formation of the metal oxide layer.

Yu teaches that an ozone containing oxidation process is carried out to treat the metal oxide layer (high-k layer) following the formation of the metal oxide layer. Col.2 lines 27-47 and col.5 lines 1-17.

It would have been obvious to one of ordinary skill in the art to perform an ozone containing oxidation process to treat the metal oxide layer following the formation of the metal oxide layer as taught by Yu et al. in order to eliminating crystallization, reduce the required thickness to achieve an equivalent SiO<sub>2</sub> thickness. Col.5 lines 6-17.

### **Conclusion**

5. Papers related to this application may be submitted to Technology center (TC) 2800 by facsimile transmission. Papers should be faxed to TC 2800 via the TC 2800 Fax center located in Crystal Plaza 4, room 4-C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (November 15,

Art Unit: 2811

1989). The Group 2811 Fax Center number is (703) 872-9306. The Group 2811 Fax Center is to be used only for papers related to Group 2811 applications.

6. Any inquiry concerning this communication or any earlier communication from the Examiner should be directed to CUONG Q NGUYEN whose telephone number is (571) 272-1661. The Examiner is in the Office generally between the hours of 6:30 AM to 5:00 PM (Eastern Standard Time) Monday through Thursday.

7. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor Eddie Lee who can be reached on (571) 272-1732.

8. Any inquiry of a general nature or relating to the status of this application should be directed to the Technology Center Receptionists whose telephone number is 308-0956.

A handwritten signature in black ink, appearing to read 'Cuong Nguyen', with a long vertical line extending downwards from the end of the signature.

Cuong Nguyen

Primary examiner

3/31/05